Title: Abatement of Ammonia and Hydrogen Sulfide Emissions From A Swine Lagoon Using A Polymer Biocover

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Interpretive Summary:

Emissions of ammonia (NH_3) and hydrogen sulfide (H_2S) above 45.4 kg*day^{-1} are subject to reporting requirements under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA; 40 C.F.R. Part 302). Determination of whether emissions from concentrated animal feeding operations (CAFOs) approach these reporting thresholds depends upon accurate measurement of emission rates under field conditions. Additionally, the development of strategies for abatement of emissions from CAFOs may allow CAFOs with emissions approaching the reporting thresholds to avoid CERCLA reporting requirements. Research results described in this report provide important insight for State and Federal regulatory agencies (State Air Quality Enforcement Divisions and U.S. EPA) into the successful use of micrometeorological methods for monitoring NH_3 and H_2S emissions from animal waste lagoons and for evaluation of emission abatement strategies. Additionally, research results from this study represent important information for individual swine producers and for commodity groups (National Pork Producers Council and State pork producer organizations) who have interest in reducing fugitive emissions from stored swine effluent.

Technical Abstract:

The purpose of this research was to determine the efficiency of a polymer biocover for abatement of hydrogen sulfide (H_2S) and ammonia (NH_3) emissions from an east-central Missouri swine lagoon with a total surface area of 7,800 m^2. The flux rate of NH_3, H_2S, and methane (CH_4) was monitored continuously from two adjacent, circular (d = 66 m) control and treatment plots using a nonintrusive, micrometeorological method during three independent sampling periods that ranged between 52 and 149 hours. Abatement rates were observed to undergo a temporal acclimation event, where NH_3 abatement efficiency improved from 17% to 54% ($p<0.0001$ to 0.0005) and H_2S abatement efficiency improved from 23% to 58% ($p<0.0001$) over a period of 3 months. The increase in abatement efficiency for NH_3 and H_2S over the sampling period was correlated with the development of a stable anaerobic floc layer on the bottom surface of the biocover that reduced mass transfer of NH_3 and H_2S across the surface. Analysis of methanogensis activity showed that the biocover enhanced the rate of anaerobic digestion by 25% when compared to the control. The biocover-enhanced anaerobic digestion process was shown to represent an effective mechanism to counteract accumulation of methanogenic substrates in the biocovered lagoon.